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Nesting Biology of *Microstigmus myersi* Turner, a Wasp With Long-haired Larvae (Hymenoptera: Sphecidae, Pemphredoninae)

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Abstract.—This paper describes the nesting habits of *Microstigmus myersi*, a species which builds nests with dirt particles hanging on fine roots in banks. The nest has no petiole and rests directly on the end of a rootlet. The entrance is shaped like a tube and is located in the lower part, whereas the cells are located above, forming the upper part of the nest. This species performs semiprogressive provisioning and preys on Thysanoptera nymphs. *Microstigmus myersi* larvae have long hairs on their body. Considering the orientation of the brood cells of this species, the larval hairs seem to represent an adaptation that may permit better support within the cells. The larvae have spinnerets and spin a cocoon, in contrast to what occurs in most other *Microstigmus* species. The nests of *M. myersi* are parasitized by *Heterospilus* sp. (Braconidae), and also by *Ceraphron* sp. (Hymenoptera, Ceraphronidae). The large number of cells in some of the nests seems to indicate long duration of these nests and, indirectly, the possibility of reuse by descendants. The nests normally contain more than one female and some males.

The genus *Microstigmus* Ducke is a highly interesting group within the Sphecidae, especially because of its nests and the social behavior exhibited by some of its species (Matthews 1968a, 1968b, 1991; Richards 1972; West-Eberhard 1977; Ross and Matthews 1989a). In general the nests are small sacs built with particulate material aggregated with silk produced by females (Matthews 1968b; West-Eberhard 1977; Matthews and Starr 1984). In most species these sacs hang on a fine petiole (West-Eberhard 1977).

Although *Microstigmus* is widely distributed in the Neotropical region, little is known about its biology. Only *M. comes* Krombein, a species found in Costa Rica, has been studied in some depth. This species nests under the leaves of palms of the genus *Cryosophyla* Blume and builds spherical nests using material scraped off the bottom surface of the leaves (Matthews 1968b; Matthews and Starr 1984). Ross and Matthews (1989a, 1989b) have presented evidence that most of the colonies may be eusocial, with task division among females based on size.

Some aspects of the nesting biology of *M. myersi* Turner were first reported by Myers (1934). Myers did not provide a very detailed report on the biology of *M. myersi* but stated that the nest is quite similar to that of *M. theridii* Ducke in general appearance, size and structure. The nest found by him was suspended by a long fine rootlet, under a bank, and had numerous earth pellets incorporated in the walls.

The present paper reports on aspects of the nesting habits of *M. myersi*. The descriptions are based on ten nests collected on the campus of the Federal University of Viçosa (MG), Brazil, from April 1989 to January 1992. Nest structure and cell contents were examined under a stereoscopic microscope. Observations made directly at the nesting sites on other nests that were not collected are also reported. The species was identified by the first author. Vouchers specimens are deposited in the Entomological Museum of the Federal University of Viçosa and in the Museu de Zoologia da Universidade de São Paulo (MZSP).

NESTING SITE AND NEST ARCHITECTURE

Nests of *M. myersi* were found only on steep banks mainly along roads and paths inside or close to wooded areas. As described by Myers (1934), the nests hang from fine rootlets. In general they are inconspicuous because of their similarity to the numerous dirt clumps also hanging from fine roots (Fig. 1). The schematic drawing presented in Fig. 1 is typical of the banks used by *M. myersi* (presence

of an upturned edge in the upper part containing many root ends). Normally the nests are not clustered, although as many as four nests were found close to one another in the same bank.

The nest architecture is quite different from that found in other *Microstigmus* species whose nest architecture is known. The nest has no petiole and rests directly on the end of a rootlet. The entrance is shaped like a tube and is located in the lower part, whereas the cells are located above, forming the upper part of the nest (Fig. 2). In new nests, all cells are vertically oriented with their opening looking down (Fig. 3b). As the nest grows, additional cells are oriented obliquely (Fig. 3a).

Fig. 1. Cross-section of a typical bank used as nesting site by *Microstigmus myersi*. Only one nest is represented in the sketch.

Fig. 2. Nest of *Microstigmus myersi*. Note the silk around the suporting rootlet on the upper part of the nest. Scale line = 5mm.

The walls of the nest are built with dirt particles aggregated with silk produced by females. Internally, the nest is fully lined with silk. The region of transition between the supporting root and the nest wall on the upper part is covered with a lot of silk, which gives it a whitish color. In general, the nests are built at the end of the rootlets, so that the rootlet tip is always inside the nest. However, in some nests the root extends beyond the nest (Fig. 3b).

In most of the nests found, the outlines of the cells can be discerned on the outer surface of the nest (Fig. 2), although one nest had a spherical outer contour (Fig. 3a). This latter nest was covered with a weak layer of dirt particles and, judging from the number of cells (23), appeared to be quite old. Observations revealed that these particles are gradually brought by females and attached to the outer part of the nest with silk. The females climb up the supporting root to the region where the root penetrates the bank and bring back dirt particles holding them between their mandibles. It seems that all nests tend to develop a smoother outer surface as they get older.

West-Eberhard (1977, Fig. 2B) has presented a schematic drawing of a nest with architecture similar to that of *M. myersi*. The author refers to this nest as belonging to a new well-distinct species. It is possible that this species belongs to the same group as *M. myersi*.

The differences between the nests of *M. myersi* found at Viçosa and that described by Myers may

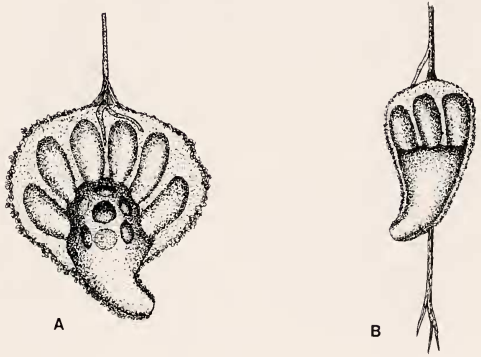

Fig. 3. Cross-section of *Microstigmus myersi* nests: a - old nest; b - newly founded nest.

be due to an error he made in describing the orientation of the nest. On the other hand, the material found in Viçosa may belong to another species closely related to *M. myersi*.

NEST CONTENTS AND IMMATURES

Table 1 summarizes the contents of the nests. The cells of *M. myersi* are provisioned with Thysanoptera nymphs and not with Collembola, as suggested by the title of the study by Myers (1934). *Microstigmus myersi* performs semi-progressive provisioning since cells with eggs contained only 3 to 15 Thysanoptera nymphs. Furthermore, the nymphs are placed loose within the cell and do not form a compact mass as observed in species performing mass provisioning. The number of prey in cells with immature larvae was similar to that found in cells with eggs, excepting some immature larvae that were found in cells that did not contain food provisions. As in other *Microstigmus* species, the preys are supported in the cells by silk threads.

Contrary to what is observed for most Apocrita, *M. myersi* larvae have long hairs on their body. In 1st- and 2nd-instar larvae, the hairs are short (Fig. 4b), whereas in older larvae they are longer and curved at the end (Fig. 4a). Among Sphecidae, hairy larvae are encountered only in a few genera not related to *Microstigmus* (Evans 1959).

Considering the orientation of the brood cells of this species, the hairs of *M. myersi* larvae seem to represent an adaptation that may permit better support within the cells. These hairs may attach to the silk threads placed by female on the cell bottom to support eggs and prey, thus permitting the larva to stay suspended within the cell. There are evidences that the nest architecture of *M. myersi* evolved independently from that found in the species with pendulous nests and with glabrous larvae (Melo, in prep.).

Lanham (1979) stated that the larval hairs found in ants and allodapine bees probably represent an adaptation for life in a communal brood chamber. Lanham (1980), in a discussion on the origin of

Table 1. Contents of *Microstigmus myersi* nests collected in Viçosa (MG), Brazil.

NEST	ADULTS		NUMBER	EMPTY	NUMBER OF CELLS WITH						
NUMBER	F	M	OF CELLS	CELLS	PREYS[a] ONLY	EGG	LARVA	PREPUPA	PUPA F	PUPA M	PARASITES
—	-	-	23	14	0	03	02	02	2	0	0
—	1	0	03	01	0	02	0	0	0	0	0
A	5	3	12	01	01	01	01	04	4	0	0
B	1	2	07	02	0	02	02	0	1	0	0
296	2	1	08	0	01	0	02	03	1	1	0[b]
328	2	0	18	05	01	01	03	03	3	1	01[c]
376	3	1	09	01	03	01	01	0	2	0	01[b]
584	2	1	08	0	01	01	01	0	2	2	0
586	4	2	13	05	01	02	0	0	2	0	03
589	1	0	07	0	01	02	02	02	0	0	0

a. Although *Microstigmus myersi* exhibits semi-progressive provisioning, the number of cells that possess only thrips nymphs is also indicated.
b. *Heterospilus*.
c. *Ceraphron*.

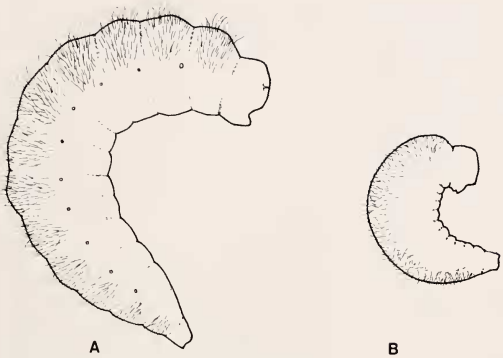

Fig. 4. Larvae of *Microstigmus myersi*: a - predefecating larva; b - young larva. Scale line = 1mm.

bees, hypothesizes that in the yet unstudied species of *Microstigmus* there may be found an evolutionary sequence in which cell making is abandoned and the larvae have become hairy. As previously mentioned, although *M. myersi* has hairy larvae, the immatures of this species are reared in individual cells. In all *Microstigmus* species whose nest architecture is known, the immatures are reared in individual cells.

Microstigmus myersi larvae have spinnerets and spin a cocoon, in contrast to what occurs in most other *Microstigmus* species (Melo, in prep.). After cocoon spinning, the larvae orient with their head facing outward and their anal end facing the vestibule. All prepupae and pupae were found within a cocoon and facing outward. The adults make holes in the cocoon in the region of cell opening and remove the larval feces. The feces stick to the inner wall of the cocoon and are not always fully removed by the adults. This cleaning behavior by the adults was inferred from the observation of the cap of cells containing predefecating larvae, prepupae and pupae. The cells are probably cleaned completely only after imago emergence.

PARASITOIDS

The nests of *M. myersi* are parasitized by a species of *Heterospilus* Haliday differing from *H. microstigmi* Richards (Braconidae). *Heterospilus microstigmi* is testaceous in color and its larvae spin a thin cocoon, while this other species has a black body and its larvae spin a very rigid cocoon.

The imagoes of this *Heterospilus* species emerge from the cell through a hole in the cocoon which they make at the end facing the outer side of the nest. It is common to find cells which have been opened outward and are closed inside and which are lined with a rigid cocoon, indicating an emergence by the parasitoid.

Microstigmus myersi adults apparently are unable to open these cocoons, so that parasitized cells become useless. In some older nests, the entire upper part of the nest can be formed by this type of cell. In general, the opening made in the cocoon by the parasitoid is closed by the wasps with silk and dirt particles.

In one nest (N376), we also found a cell parasitized by a species of *Ceraphron* Jurine (Ceraphronidae), in which five larvae were eating a prepupa.

SOCIAL ORGANIZATION

Little can be inferred about the social organization of *M. myersi* from the present data. The large number of cells in some of the nests seems to indicate long duration of these nests and, indirectly, the possibility of reuse by descendants. Cell reuse was also inferred by the presence of eggs or

immature larvae in cells lined with cocoons. The nests normally present more than one female and some males (Table 1). The relationship between number of cells with eggs and larvae and number of females does not permit us to draw conclusions about the occurrence of dominance among females. Although no quantitative analysis was performed, nest-sharing females do not exhibit marked differences in size.

Adults walking over the nest are commonly observed, a behavior which appears to be related to defense against parasitoids, as also observed by Matthews (1968b) in *M. comes*. Since the males of *M. myersi* are not easily distinguished from females in field conditions, we do not know if the males also exhibit this behavior.

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